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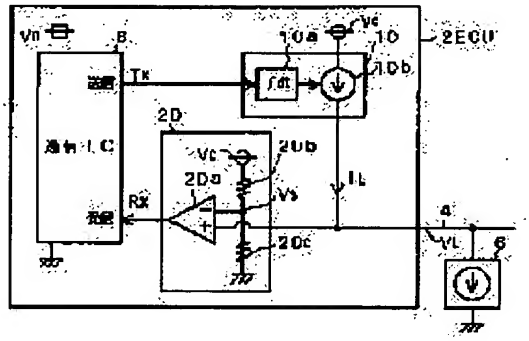
(54) DATA COMMUNICATION EQUIPMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide the data communication equipment by which a radiation noise from a transmission line can be suppressed in an excellent way and accurate data communication can be realized.
SOLUTION: An ECU 2 making serial data communication through a transmission line 4 is provided with a driver circuit 10 consisting of an integrator 10a integrating a transmission signal Tx and of a current source 10b generating a current iL in response to an integrated value and supplying the current to the transmission line 4 and with a reception circuit 20 to compare a voltage level VL of the transmission line 4 with a criterion voltage Vs to generate a reception signal Rx. Furthermore, a termination circuit 6 to receive a constant current it smaller than a maximum current supplied by the driver circuit 10 is connected to the transmission line 4. In this equipment, since the output current iL from the driver circuit 10 is changed gradually, the production of the emitted noise from the transmission line 4 is prevented and since the voltage of the transmission line 4 is changed rapidly to a high or low level depending on the quantity relation between the output current iL and the absorbed current (it), accurate data communication is attained.



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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The data communication unit characterized by providing the following. Two or more communication devices. In the data communication unit with which it has the transmission line which connects each communication device mutually, and each communication device transmits and receives serial data through this transmission line, to the communication device which performs data transmission The current which responds to a sending signal, and the amount of current increases gradually and dwindles is generated, and the driver circuit which flows out or flows this current to the aforementioned transmission line is prepared. to the aforementioned transmission line The aforementioned driver circuit consists of a constant current source which passes predetermined fixed current smaller than the maximum of the amount of current in which an outflow or an inflow is possible to the aforementioned transmission line. Intake of the current out of which the aforementioned driver circuit flowed into the transmission line with this fixed current, Or the receiving circuit which becomes the communication device which prepares the termination circuit which supplies the current to the aforementioned driver circuit which flows current from this transmission line, and performs data reception from the voltage comparator circuit the voltage level of the aforementioned transmission line judges whether it is more than predetermined level to be.
[Claim 2] The aforementioned driver circuit is a data communication unit according to claim 1 characterized by having an integration means to integrate with the aforementioned sending signal, and the current source which generates the current according to the integration value by this integration means.
[Claim 3] The data communication unit according to claim 1 or 2 characterized by the sum total of the amount of current which connects two or more aforementioned termination circuits to the aforementioned transmission line, and each termination circuit passes constituting so that the aforementioned driver circuit may become small to the aforementioned transmission line rather than the maximum of the amount of current in which an outflow or an inflow is possible.
[Claim 4] the claim 1 characterized by for the aforementioned transmission line consisting of twisted pair wires which consist of a signal line of a couple, equipping the aforementioned driver circuit and the aforementioned termination circuit with the current source of the couple which passes current to an opposite direction mutually to each signal line of the aforementioned transmission line, respectively, and the aforementioned receiving circuit performing the size judging of the voltage level of each signal line of the aforementioned transmission line - a claim 3 -- either -- the data communication unit of a publication

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to a suitable data communication unit to perform data communication between the electronic instruments carried [especially] in the automobile etc. about the data communication unit which transmits and receives serial data through the transmission line.
[0002]
[Description of the Prior Art] Conventionally, in this kind of data communication unit, adjusting the inclination of the output wave of the driver circuit which outputs a sending signal to the transmission line is performed so that a radio noise may not be emitted from the transmission line at the time of the start of a sending signal, and falling.
[0003] For example, a capacitor is formed between I/O of the output stage which made push pull connection of MOS-FET of a P channel and an N channel as indicated by JP,2-119443,A. By constituting so that it may respond to a sending signal to an output stage and a constant current may be made to flow or flow out of the input-stage side which receives a sending signal Change of the output voltage from the start of an input signal, and the output stage at the time of a fall To the transient between the stable state from which it restricts to the inclination decided by the capacity and the amount of current of a capacitor, and output voltage moreover becomes fixed, and the change state of changing with a predetermined inclination As indicated by the driver circuit to which it was made to change output voltage more slowly, and JP,4-284757,A with the property of MOS-FET prepared in the output stage A logarithmic-function circuit etc. is used at the time of the start of output voltage, and a fall. A steep change of the output voltage from driver circuits, such as a driver circuit to which it was made to change output voltage in the shape of a sine wave, is suppressed, and the data communication unit which prevented that a radio noise occurred in the transmission line is known.
[0004] Moreover, it constitutes as a current drive type driver circuit which makes a constant current flow [flow and a driver circuit is flowed out / driver circuit / to each signal line of a twisted pair wire], the symmetric property of current which flows to a twisted pair wire is secured, and the data communication unit which enabled it to offset more the noise generated in the transmission line between each signal line is also known as indicated by JP,4-120930,A, for example.
[0005]
[Problem(s) to be Solved by the Invention] However, in the data communication unit indicated by JP,2-119443,A, since a driver circuit was not able to be realized by the cheap bipolar transistor since it is what suppresses change of the output voltage from a driver circuit using the property of MOS-FET, or the output stage of a driver circuit was made push pull composition, there was a problem that it could use only for the communication mode with which the sending signal from each communication device, such as a master slave and token passing, does not collide among the data communication between the communication devices of a lot or multiplex communication.
[0006] On the other hand, in the data communication unit indicated by JP,4-284757,A, since it

can apply also to the communication mode with which the transmission from each communication device, such as CSMA/CD, collides and the edge section of an output voltage wave is made into the shape of a sine wave, the higher harmonic theoretically generated at the time of the start of a sending signal and falling can be suppressed good. However, in order to be greatly dependent on the temperature characteristic of the semiconductor with which circuitry becomes complicated or the output voltage wave from the driver circuit constitutes a logarithmic transformation circuit etc. from this data communication unit since it is necessary to prepare the logarithmic transformation circuit which changes an output voltage wave to a driver circuit in the shape of a sine wave, under the conditions which change a lot, the problem that the stable output voltage wave is not acquired also has an operating environment like an automobile.

[0007] And especially, with these data communication units, since it is what suppresses a radio noise by suppressing the steep change at the time of the standup of the output voltage wave from a driver circuit, and falling, when stray capacity occurs in the transmission line, there is a problem that ideal noise depressor effect is not obtained. That is, at the time of the start, even if the radiated noise generated in the transmission line suppresses a steep change of the output voltage wave from a driver circuit, since the current wave form which flows to the transmission line will change steeply, it is difficult the radiated noise, if stray capacity exists in the transmission line depending on the variation of the current per unit time to remove the radiated noise from the transmission line completely in the data communication unit which adjusted the output voltage wave of a driver circuit.

[0008] Moreover, in the data communication unit indicated by JP,4-120930,A, if an output transistor is saturated, since the noise reduction effect will fall remarkably, apart from an I/O circuit or a termination circuit, a clamping circuit is needed. And since this clamping circuit needs the power supply of exclusive use so that clearly also from the example of the above-mentioned official report, there is a problem that a power supply must always be supplied in this clamping circuit, irrespective of communicative necessity. Moreover, since the output current from a driver circuit is controlled by this data communication unit, although it is few, since differential transmission by the twisted pair wire is the requisite, with it, the problem of being inapplicable also has the influence by the stray capacity on the transmission line on the communication device using the one transmission line.

[0009] applying a driver circuit equivalent to the equipment indicated by JP,4-120930,A on the other hand to the system which constituted the transmission line from one signal line, dulling change of the output current from a driver circuit, and suppressing the radiated noise from the transmission line, although things are also considered When a resistor is used for a termination circuit as indicated by this official report, the voltage of the transmission line In the receiving circuit which becomes a voltage waveform proportional to the output current from a driver circuit, or becomes the voltage waveform which became blunt further rather than the output current for the stray capacity of the transmission line, and receives the sending signal from a driver circuit The problem of it becoming impossible to receive a sending signal good occurs. That is, since a receiving circuit consists of voltage comparator circuits, such as a comparator, if its voltage waveform of the transmission line generally becomes blunt, the input signal obtained in a receiving circuit will become that in which it is not only delayed, but the pulse width of an input signal differs from a sending signal by distortion of a voltage waveform to a sending signal, and a good receiving property will no longer be acquired.

[0010] And if delay of the signal in the path from a driver circuit to a receiving circuit through the transmission line becomes large especially in the case of the access method on condition of the collision of CSMA/CD etc. Since it becomes impossible to perform data communication correctly, in order to apply the current drive type driver circuit indicated by the above-mentioned official report in such a system It becomes very difficult for a voltage waveform to suppress a radiated noise, securing communication precision, within tolerance since it becomes easy to generate a radiated noise, if a current wave form cannot be dulled so that it may only become to become blunt, and **** of a current wave form is made small.

[0011] this invention is made in view of such a problem, can suppress the radiated noise from the transmission line good also in the system which performs data communication on condition

of the collision of transmission signals, such as CSMA/CD, using the one transmission line, and aims at offering the data communication unit which can moreover realize exact data communication.
[0012]
[Means for Solving the Problem] Invention according to claim 1 made in order to attain this purpose In the data communication unit with which it has the transmission line which connects mutually two or more communication device and each communication device, and each communication device transmits and receives serial data through this transmission line The current which responds to a sending signal, and the amount of current increases gradually and dwindles is generated in the communication device which performs data transmission, and the driver circuit which flows out or flows this current to the aforementioned transmission line is prepared in it. to the aforementioned transmission line The aforementioned driver circuit consists of a constant current source which passes predetermined fixed current smaller than the maximum of the amount of current in which an outflow or an inflow is possible to the aforementioned transmission line. Intake of the current out of which the aforementioned driver circuit flowed into the transmission line with this fixed current, Or it is characterized by having prepared the termination circuit which supplies the current to the aforementioned driver circuit which flows current from this transmission line, and preparing the receiving circuit which consists of a voltage comparator circuit the voltage level of the aforementioned transmission line judges whether it is more than predetermined level to be in the communication device which performs data reception.
[0013] Thus, in the data communication unit of the constituted this invention (claim 1), in case a certain communication device performs data transmission, the driver circuit prepared in the communication device flows out gradual increase and the current to dwindle to the transmission line according to a sending signal, or flows from the transmission line. And the termination circuit connected to the transmission line supplies current to the driver circuit which absorbs the current out of which the driver circuit flowed into the transmission line, or flows current from the transmission line.
[0014] Moreover, since this termination circuit consists of a constant current source which passes predetermined fixed current with a driver circuit smaller than the maximum of the amount of current in which an outflow or an inflow is possible, For example, if it is constituted so that a driver circuit may flow current into the transmission line, and the maximum current sets to it (it<id) current value of the fixed current which id and a termination circuit absorb According to the level (High-Low) of the sending signal inputted into a driver circuit, the voltage level of the transmission line can change as follows, and can receive a sending signal now correctly from the voltage level of this transmission line in the communication device side equipped with the receiving circuit.
[0015] That is, the sending signal inputted into a driver circuit is Low first. Current iL which will flow out of a driver circuit into the transmission line if it changes from level to High level (output current) It increases from "0" gradually. And the output current iL The potential (voltage level) of the transmission line is Low until it reaches the fixed current it which a termination circuit absorbs. It is held at level.
[0016] Moreover, the output current iL from a driver circuit Although it operates so that a driver circuit may make the output current increase further since there is capacity to which the output current is made to increase further to Maximum id in a driver circuit even if it reaches the fixed current it which a termination circuit absorbs, a termination circuit is the output current iL from a driver circuit. If fixed current it is exceeded, since all the current that the driver circuit outputted cannot be absorbed, the potential on the transmission line increases rapidly. And if the voltage level of the transmission line becomes near the supply voltage to a driver circuit, it will become impossible to make current increase more than by it, the voltage level of the transmission line will turn into High level, and the output current of a driver circuit will be stabilized by the driver circuit in the state where it became fixed current it which a termination circuit passes.
[0017] Next, the sending signal inputted into a driver circuit is High level to Low. If reversed on

level, a driver circuit is the output current iL. You are going to make it decrease. And the output current iL from a driver circuit If it decreases rather than the fixed current it which a termination circuit absorbs, in order that the direction of a termination circuit may absorb more current, the potential of the transmission line is Low for the first time about descent rapidly. It is set to level. And even if the output current of a driver circuit continues decreasing to **** after that, the potential of the transmission line is Low. It is held at level and does not change.

[0018] Therefore, in the data communication unit of this invention, although the drive current flowed out and (or inflow) made the transmission line by operation with such a driver circuit and a termination circuit from a driver circuit changes only to ****, the potential (voltage level) of the transmission line will change rapidly according to the sending signal inputted into a driver circuit. In addition, since it operates contrary to the above-mentioned explanation when it is constituted so that a driver circuit may flow current from the transmission line, the potential (voltage level) of the transmission line will change rapidly like the above-mentioned explanation according to the sending signal inputted into a driver circuit.

[0019] For this reason, the voltage comparator circuit which constitutes a receiving circuit according to this invention is the High level and Low of the transmission line about the voltage level for a judgment in comparison with the voltage level of the transmission line. By setting it as the any value between level Data communication between communication devices can be performed correctly, without being stabilized, being able to receive the sending signal inputted into the driver circuit in the receiving circuit, and setting up strictly the voltage level for a judgment in a receiving circuit.

[0020] Moreover, it can prevent that this noise affects other equipments, such as a radio set, by suppressing the radiated noise from the transmission line since the current which flows to the transmission line changes only to ****. And especially, according to this invention, even if it dulls change of the output current from a driver circuit greatly for such noise rejection, since it changes suddenly when the time delay determined with change (inclination) of the output current from a driver circuit and the fixed current which a termination circuit passes is passed, the voltage level of the transmission line can restore a sending signal by the receiving-circuit side after change of a sending signal, without being influenced by the change property of the output current from a driver circuit. For this reason, according to this invention, it is easily applicable even if it is the data communication unit of the access method on condition of the collision of CSMA/CD etc.

[0021] Moreover, the current which a driver circuit flows out and (or inflow) makes the transmission line in the data communication unit of this invention is inhaled in a termination circuit (or supply). And by a driver circuit's flowing out (or inflow) and setting the amount of current which this termination circuit absorbs (or it supplies) as a value smaller than the possible amount of maximum currents since the amount of current which a driver circuit flows out and (or inflow) makes the transmission line was restricted and the voltage level of the transmission line was rapidly changed by this, the current drive type driver circuit was used -- it is not necessary to prepare a clamping circuit apart from a termination circuit, and an equipment configuration can be simplified like equipment before

[0022] Here, for a driver circuit, a sending signal is Low. From level, High level or when [that] conversely reversed The amount of current flowed out and (from the transmission line to or an inflow) made into the transmission line is increased gradually or dwindled, and a sending signal is Low from High level. Although the amount of current flowed out and (from the transmission line to or an inflow) made into the transmission line is made to dwindle or increase gradually level or when [that] conversely reversed Such a driver circuit can be constituted very easily, for example by [according to claim 2] using like, and an integration means to integrate with a sending signal and the current source which generates the current according to the integration value by this integration means.

[0023] Moreover, although they can realize this invention even if the number of the termination circuits which consist of a constant current source linked to the transmission line is one, in order to secure data communication when a termination circuit breaks down, a thing [preparing two or more termination circuits in the transmission line] according to claim 3 is [like]

desirable. And what is necessary is just to constitute so that the sum total of the amount of current which two or more of the termination circuits pass like according to claim 3 may become smaller than the maximum of the amount of current which a driver circuit flows [an outflow or] in this case.
[0024] that is, when doing in this way and a certain termination circuit breaks down Compared with the case where all termination circuits are carrying out normal operation, the amount of current absorbed from a driver circuit (or a driver circuit is supplied) decreases. Although time after a driver circuit starts the outflow (or inflow) of current until the voltage level of the transmission line is reversed becomes short, the voltage level of the transmission line Since it changes suddenly according to change of a sending signal, in a receiving-circuit side, a sending signal can be restored now like the time of normal, and abbreviation, and it becomes possible to continue data communication like the time of normal. Consequently, according to equipment according to claim 3, the reliability of equipment can be improved more.
[0025] Moreover, by next, operation with the termination circuit by which the data communication unit of this invention was connected as mentioned above with the driver circuit prepared in the communication device at the transmission line Since it is the thing which makes the voltage level of the transmission line change suddenly according to the sending signal into which it was inputted by the driver circuit, suppressing the radiated noise which the current which flows to the transmission line is changed to ****, and is generated in the transmission line, although it is easily realizable also in the system which constituted the transmission line from one signal line The transmission line is constituted from a twisted pair wire according to claim 4 which consists of a signal line of a couple like. Prepare mutually the current source of the couple which passes current in an opposite direction to each signal line of the transmission line, and if a receiving circuit is constituted in a driver circuit and a termination circuit so that the size judging of the voltage level of each signal line of the transmission line may be performed, to them, respectively Since a higher-harmonic noise can be made to offset between the signal lines of the couple which constitutes the transmission line, the radiated noise from the transmission line can be suppressed more certainly.
[0026]
[Embodiments of the Invention] The example of this invention is explained below. Drawing 2 is an outline block diagram showing the composition of the whole data communication unit for automobiles of an example with which this invention was applied first.
[0027] As shown in drawing 2 , the data communication unit of this example The various electronic controls (ECU) 2a, 2b, 2c, --, 2n the object for engine control carried in the automobile, the object for transmission control, for slip control, etc. Respectively, it connects by the one transmission line 4, the control data showing the control state of the detection data which detected the various operational status of vehicles through the transmission line 4 in these ECU2a-2n, or a controlled system etc. is transmitted and received, and the so-called LAN for vehicles which attains common use-ization of data is built. And fixed current is absorbed in the ends of the transmission line 4 from the transmission line 4, and the termination circuit 6 of the couple which consists of a constant current source dropped on the body used as a ground line (ground) is connected to them, respectively.
[0028] As shown in drawing 1 , moreover, to each above-mentioned ECU2 (2a-2n) The controlled variable of the engine which is a controlled system, transmission, etc. is calculated. Apart from the control circuit (it usually consists of microcomputers) for carrying out drive control of the corresponding actuator, or a drive circuit In response to the transmit data outputted from this control circuit, change into the serial data Tx for transmission (sending signal), and a driver circuit 10 is minded for this changed sending signal Tx. It sends out on the transmission line 4, or an input signal Rx is incorporated from the transmission line 4 through a receiving circuit 20, and it has the communication IC 8 which changes this into received data and is outputted to a control circuit.
[0029] In addition, this communication IC 8 operates in response to a constant voltage VD (for example, +5V) from the power circuit for constant-voltage generation prepared in ECU2. However, the function of this communication IC 8 can be included in the control circuit in ECU2,

and processing of the microcomputer which constitutes a control circuit can also realize it.
[0030] Next, fundamentally, as shown in drawing 2 , the driver circuit 10 which outputs a signal to the transmission line 4 in response to the sending signal Tx from communication IC 8 generates the current iL according to the integration value of the sending signal Tx obtained in integrator 10a which integrates with a sending signal Tx, and this integrator 10a, and consists of current-source 10b which flows into the transmission line 4. In addition, this driver circuit 10 operates in response to the supply voltage Vc (for example, battery voltage : 12 V) supplied to the power circuit in ECU2 etc. from the outside.
[0031] Moreover, a receiving circuit 20 operates in response to the supply voltage Vc supplied from the outside like a driver circuit 10. Voltage-level VL of the transmission line 4 The resistors 20b and 20c of the couple which is for restoring a shell and the sending signal Tx from other ECUs2 as an input signal Rx, pressures supply voltage Vc partially and generates the judgment voltage Vs, Voltage-level VL of the judgment voltage Vs and the transmission line 4 generated by these resistors 20b and 20c Size comparison is carried out and it is Low at the time of High level and "VL <Vs" at the time of "VL >=Vs". It consists of comparator 20a which generates the input signal Rx used as level.
[0032] And the fixed current which the termination circuit 6 of the couple connected to the transmission line 4 absorbs from the transmission line 4 is set up so that the sum total of the amount of current may serve as the predetermined current value it smaller than the maximum id of the amount of current out of which a driver circuit 10 can flow into the transmission line 4. thus, in the data communication unit of the constituted this example, in case ECU2 performs data transmission The driver circuit 10 in ECU2 responds to the sending signal Tx inputted from communication IC 8. The output current iL which flows into the transmission line 4 The termination circuit 6 of the couple which increased gradually and gradually decreased and was connected to the transmission line 4 The voltage level of the transmission line 4 since the current out of which the driver circuit 10 flowed into the transmission line 4 absorbs is High level or Low at the predetermined timing after reversal of a sending signal Tx. It will change suddenly on level.
[0033] That is, the sending signal Tx outputted to a driver circuit 10 from communication IC 8 as shown in drawing 3 is Low. If reversed [on High level] from level, it will set to a driver circuit 10. The output voltage from integrator 10a increases from a voltage value "0" to **** with a fixed inclination. Current iL which increases to the transmission line 4 after the standup of a sending signal Tx at **** since the current according to the output voltage is generated in current-source 10b and it is outputted to the transmission line 4 It will flow. And the output current iL from this driver circuit 10 The potential of the transmission line 4 is Low until it reaches the fixed current it which is the sum total of the amount of current which the termination circuit 6 of a couple absorbs. It is held at level (0V).
[0034] Moreover, the output current iL from a driver circuit 10 Although it operates so that a driver circuit 10 may make the output current increase further since there is capacity to which the output current is made to increase further to Maximum id in a driver circuit 10 even if it reaches the fixed current it which the termination circuit 6 of a couple absorbs The termination circuit 6 of a couple is the output current iL from a driver circuit 10. If fixed current it is exceeded, since all the current that the driver circuit 10 outputted cannot be absorbed, the potential of the transmission line 4 increases rapidly. And if the voltage level of the transmission line 4 becomes near the supply voltage Vc to a driver circuit 10, it will become impossible to make current increase more than by it, the voltage level of the transmission line 4 will serve as supply voltage Vc, and the output current of a driver circuit 10 will be stabilized by the driver circuit 10 in the state where it became fixed current it which the termination circuit 6 of a couple passes (time t1).
[0035] Next, the sending signal Tx inputted into a driver circuit 10 is High level to Low. Current-source if [reversed on level] and since output voltage from integrator 10a will decrease to **** with fixed inclination within driver circuit 10 from predetermined value "H" corresponding to High level of sending signal Tx 10b is also the output current iL to the transmission line 4. It operates so that it may be made to decrease. And the output current iL with the output voltage smaller

than the current value it which the termination circuit of a couple absorbs from integrator 10a It decreases to the value to generate. The output current iL from current-source 10b If it decreases rather than the fixed current it which the termination circuit 6 of a couple absorbs, the potential of the transmission line 4 is Low for the first time about descent rapidly. It is set to level (0V) and the potential of after that and the transmission line 4 is Low. It is held at level (time t2).

[0036] Therefore, it sets to the data communication unit of this example. By operation with the termination circuit 6 of the couple connected with the driver circuit 10 prepared in ECU2 at the transmission line 4 The output current iL from a driver circuit 10 to the transmission line 4 It is voltage-level VL of the transmission line 4, making it change to **** and preventing generating of a radiated noise. Can make it change suddenly according to a sending signal Tx, and it sets to a receiving circuit 20. This voltage-level VL By performing the size judging with the judgment voltage Vs, other ECUs2 can restore now correctly the sending signal Tx sent out to the transmission line 4.

[0037] And the resistors 20b and 20c for partial pressure which determine the judgment voltage Vs in a receiving circuit 20 Since the supply voltage Vc supplied to a driver circuit 10 is pressured partially, If the resistor of the same resistance as each [these] resistors 20b and 20c is used, the judgment voltage Vs High level and Low of the transmission line 4 It can set up easily [the middle voltage value between level]. moreover, the potential of this transmission line 4 The sending signal Tx which flows to the transmission line 4 can be restored correctly, without adjusting strictly the resistance of the resistors 20b and 20c which set up this judgment voltage Vs in a receiving circuit 20 from High level Low level or in order [its] to change suddenly conversely.

[0038] Moreover, although it integrates with a sending signal Tx in a driver circuit 10 and current is made to flow into the transmission line 4 in the amount of current according to the integration value in this example in order to suppress the radiated noise from the transmission line 4 Since the voltage waveform of the transmission line 4 changes in the shape of a square wave regardless of the wave (inclination) of this output current, in a receiving-circuit 20 side A sending signal can be restored without being influenced by the change property of the output current from a driver circuit 10, and it is easily applicable even if it is the data communication unit of the access method on condition of the collision of CSMA/CD etc.

[0039] That is, a time delay after the sending signal Tx inputted into a driver circuit 10 is reversed, until the potential of the transmission line 4 changes is [the time delay of integrator 10a which constitutes a driver circuit 10, and current-source 10b, and] the output current iL. An inclination and the current value which the termination circuit 6 of a couple passes are determined. Although this time delay changes with the stray capacity of the transmission line 4 etc. a little, since the driver circuit 10 makes the output current increase according to delay, it can make the time difference of potential change small. For this reason, the pulse width of an input signal Rx and the pulse width of a sending signal Tx which are obtained by the receiving circuit 20 differ from each other greatly, or it has not said that the pulse width of an input signal Rx changes with service conditions, and even if it is the data communication unit of the access method on condition of the collision of CSMA/CD etc., exact data communication can be realized.

[0040] Moreover, in this example, since the termination circuit 6 of a couple is connected to the ends of the transmission line 4, even when one termination circuit 6 breaks down or the transmission line 4 is disconnected on the way, between ECUs2 connected through the transmission line 4, data communication can be carried out to an abbreviation normal passage, and the reliability of equipment can be improved. Since current can be absorbed from the transmission line 4 by one termination circuit 6 even if such abnormalities occur, that is, at the time of unusual generating The current which a termination circuit 6 absorbs from the transmission line 4 becomes less than the time of normal, and it is voltage-level VL of after reversal of a sending signal Tx, and the transmission line 4. Although time until it is reversed becomes short, by change of such a time delay Since the pulse width of the input signal Rx generated by the receiving circuit 20 does not change a lot, data communication can be

continued.
[0041] What is necessary is here, for this driver circuit 10 just to more specifically consist of above-mentioned examples, as shown in drawing 4 (a) or (b), although the driver circuit 10 was explained as what is constituted by integrator 10a and current-source 10b. Hereafter, each [these] driver circuit is explained.
[0042] First, drawing 4 (a) expresses the circuit diagram at the time of realizing a driver circuit 10 by the minimum discrete circuit. As shown in drawing 4 (a), this driver circuit 10 is equipped with two transistors of the NPN type transistor TR11 and the PNP type transistor TR12. And while the base of a transistor TR11 is connected to the output port of the sending signal Tx of communication IC 8 through a resistor R11, it is grounded by the ground line through a resistor R12, and a collector is connected to the power supply line which supplies supply voltage Vc through a resistor R13 and a resistor R14, and the emitter is grounded by the ground line. Moreover, the base of a transistor TR12 is connected to the node of a resistor R13 and a resistor R14, an emitter is connected to a power supply line through an inductor L11, and the collector is connected to the transmission line 4.
[0043] Thus, with the constituted driver circuit 10, the sending signal Tx from communication IC 8 is Low. If reversed [on High level] from level, by the signal pressured partially by the resistor R11 and the resistor R12, current flows into the base of a transistor TR11, and a transistor TR11 will be in ON state. And if a transistor TR11 will be in ON state, since current will flow through a resistor R13, a resistor R14, and a transistor TR11, the base of a transistor TR12 will become lower than supply voltage and a resistor R14 will draw the base current of a transistor TR12, a transistor TR12 will also be in ON state.
[0044] In this way, if a transistor TR12 will be in ON state, although current will be rapidly passed to the transmission line 4 and it will consider as the method of beginning, since the inductor L11 is formed in the emitter side of a transistor TR12, an inductor L11 prevents a rapid current change, and it is the output current (collector current) iL from a transistor TR12 to the transmission line 4. It increases to ****.
[0045] Consequently, the current with which it integrated by the sending signal Tx from communication IC 8 will be outputted to the transmission line 4. That is, in this driver circuit 10, an inductor L11 and a transistor TR12 function as an integrator and a current source, and it operates as a drive control circuit to which a transistor TR11 and resistors R11-R14 carry out drive control of these each part according to the sending signal Tx from communication IC 8.
[0046] Moreover, it sets to this driver circuit 10, and the sending signal Tx from communication IC 8 is Low. If reversed on level, a transistor TR11 tends to be in an OFF state, the base of a transistor TR12 tends to approach supply voltage Vc, and it is going to turn off a transistor TR12 rapidly. However, since the inductor L11 is connected to the emitter of a transistor TR12, this inductor L11 tends to raise emitter voltage with reduction in an emitter current. Consequently, it cannot turn off rapidly but a transistor TR12 is the collector current of a transistor TR12, as a result the output current iL to the transmission line 4. By the energy accumulated at the inductor L11, it will decrease to ****.
[0047] Therefore, according to the driver circuit 10 shown in drawing 4 (a), it responds to a sending signal Tx, and is the output current iL to the transmission line 4. The driver circuit increased gradually and dwindled is cheaply realizable with the easy composition which consists of two bipolar transistors, resistors, and inductors.
[0048] By the way, an inductor L11 is used in the driver circuit 10 shown in drawing 4 (a), and it is the output current iL to the transmission line 4. Although it is made to make it change to ****, this circuit is difficult for IC-izing, and since an inductor L11 is used, when IC-izing, it needs to carry out external [of the inductor L11] separately.
[0049] On the other hand, it can realize without using an inductor L11, and the driver circuit 10 shown in drawing 4 (b) expresses the driver circuit which can attain IC-ization easily. That is, the driver circuit 10 shown in drawing 4 (b) is the amount i1 of current. The amount i1 of current which the constant current source 12 which passes fixed current, and this constant current source 12 pass Amount i2 of current of double precision It has the constant current source 14 which passes fixed current. And it is prepared between the power supply lines and ground lines

which supply supply voltage Vc, and parallel connection of a capacitor C21 and the zener diode ZD21 is carried out to the constant current source 12 of a power supply line side so that each [these] constant current sources 12 and 14 may sandwich in between the switching circuit SW11 which consisted of FET etc. and current may flow from a constant-current-source 12 side to a constant-current-source 14 side.
[0050] Moreover, this driver circuit 10 is equipped with the operational amplifier OP1 and ** by which the transistor TR21 and noninverting input terminal (+) of the PNP type by which the emitter was connected to the power supply line through the resistor R21, and the collector was connected to the transmission line 4 were connected to the node of a constant current source 12 and a switching circuit SW11, the output terminal was connected to the base of a transistor TR21, and the inversed input terminal (-) was connected to the emitter of a transistor TR21.
[0051] In addition, a switching circuit SW11 operates in response to the sending signal Tx from communication IC 8, when a sending signal Tx is High level, it will be in ON state, and it is Low. When it is level, it is made to be in an OFF state. Thus, with the constituted driver circuit 10, the sending signal Tx from communication IC 8 is Low. If reversed [on High level] from level, a switching circuit SW11 turns on. At this time, both the constant current sources 12 and 14 operate, and they are fixed current i1 and i2, respectively. Although it is going to pass Fixed current i1 which a constant current source 12 passes Fixed current i2 which it receives and a constant current source 14 passes Since the direction is large, a capacitor C21 It will charge with the fixed current i1 (=i2-i1) according to the current difference, and the input voltage to the noninverting input terminal (+) of an operational amplifier OP1 falls to **** from supply voltage Vc.
[0052] Since zener diode ZD21 is connected to the capacitor C21 in parallel, in addition, the charge to a capacitor C21 When it is carried out until the ends voltage turns into predetermined voltage determined in the breakdown voltage of zener diode ZD21, and a sending signal Tx is High level, Finally the input voltage to the noninverting input terminal (+) of an operational amplifier OP1 declines to the predetermined voltage which subtracted the breakdown voltage of zener diode ZD21 from supply voltage Vc.
[0053] And the base current of a transistor TR21 will be controlled so that the emitter voltage of a transistor TR21 will become [as for an operational amplifier OP1] the same as the input voltage as for an operational amplifier OP1, if the input voltage to a noninverting input terminal (+) declines from supply voltage Vc since an output signal is generated, so that the potential of a noninverting input terminal (+) and the potential (as a result, emitter voltage of a transistor TR21) of an inversed input terminal (-) may become the same.
[0054] Consequently, the emitter current of a transistor TR21 increases to ****, and serves as an integration wave to which an inclination is set with the resistance of a resistor R21. And the collector current of a transistor TR21 is the output current iL from a driver circuit 10, in order to change like this emitter current. It will increase to **** after the start of a sending signal Tx.
[0055] Next, the sending signal Tx from communication IC 8 is High level to Low. When reversed on level, it is fixed current i1 on which a constant current source 12 passes the charge accumulated at the capacitor C21 by a switching circuit SW11 turning off in order that a constant current source 14 may stop the suction of the current from a constant-current-source 12 side. It discharges to ****. Then, contrary to the time of a switching circuit SW11 being in ON state, the input voltage to the noninverting input terminal (+) of an operational amplifier OP1 will increase to **** until it turns into the abbreviation supply voltage Vc, and it is the output current iL from a transistor TR21 to the transmission line 4. It will decrease to ****.
[0056] In addition, zener diode ZD21 is for restricting that the input voltage to the noninverting input terminal (+) of an operational amplifier OP1 becomes low too much, and it is desirable to the breakdown voltage to fully for changing a transistor TR21 into ON state completely set it as the minimum value. That is, time until the amount of current out of which a transistor TR21 turns off completely and flows into the transmission line 4 becomes zero is wanted to use the zener diode to which the breakdown voltage serves as minimum sufficient value for a transistor TR21 to turn on from a bird clapper for a long time at zener diode ZD21, if the breakdown voltage is high even if it does not form zener diode ZD21 or prepares.

[0057] Thus, the output current iL which flows into the transmission line 4 through a transistor TR21 by according to the driver circuit 10 shown in drawing 4 (b) carrying out the charge and discharge of the capacitor C21 according to the sending signal Tx outputted from communication IC 8, generating the voltage for gradual increase and the current control to dwindle according to a sending signal Tx, and inputting this voltage into the noninverting input terminal (+) of an operational amplifier OP1 It is made to be controlled. Therefore, it can realize without using an inductor like the driver circuit shown in drawing 4 (a), and IC-ization of a driver circuit 10 can be attained easily.
[0058] In addition, in the driver circuit 10 of drawing 4 (b), the capacitor C21 and constant current sources 12 and 14 which generate the voltage for current control, zener diode ZD21, and a switching circuit SW11 will operate as integrator 10a shown in drawing 1 , and an operational amplifier OP1, a transistor TR21, and a resistor R21 will operate as current-source 10b.
[0059] Next, in the above-mentioned example, although a termination circuit 6 can use from things the various current regulator circuits known from before that what is necessary is just the constant current source which absorbs fixed current from the transmission line 4, the example is shown in drawing 5 (a) - (c), and it explains it briefly. First, the termination circuit 6 shown in drawing 5 (a) is a current regulator circuit using the current Miller circuit which consists of a transistor of a couple, and is equipped with the NPN type transistors TR31 and TR32. And while connecting mutually the base of each [these] transistors TR31 and TR32, the emitter was grounded respectively, the power supply line which supplies supply voltage Vc through a resistor R31 was connected, the transmission line 4 was connected to the collector of the transistor TR32 of another side, and between the base collectors of a transistor TR31 is connected to the collector of one transistor TR31. Consequently, to one transistor TR31, the fixed current determined with supply voltage Vc and the resistance of a resistor R31 flows, and the transistor TR32 of another side comes to absorb the same fixed current as this from the transmission line 4 to it.
[0060] Next, the collector was connected to the transmission line 4 and the termination circuit 6 shown in drawing 5 (b) is equipped with the NPN type transistor TR41 with which the emitter was grounded through the resistor R42. And while the base of this transistor TR41 is connected to the anode of diode D41, it connects with the collector of a transistor TR41 through the resistor R41, and the cathode of diode D41 is further connected to the anode of the diode D42 with which the cathode was grounded. Thus, in the constituted termination circuit 6, when the potential of the transmission line 4 becomes high, through a resistor R41, current flows to diodes D41 and D42, and the base potential of a transistor TR41 is fixed to a part for the forward voltage drop of diodes D41 and D42 (about 1.2 V). In this state, since a transistor TR41 is stabilized after the emitter voltage (that is, ends voltage of a resistor R42) of a transistor TR41 has become a part for the forward voltage drop for a diode piece although it will be in ON state and absorbs current from the transmission line 4, the current which a transistor TR41 absorbs turns into fixed current determined with the resistance of the part for a forward voltage drop (about 0.6 V) and the resistor R42 for a diode piece. Therefore, also in this circuit, it will operate as a constant current source which absorbs fixed current from the transmission line 4.
[0061] With the base of the transistor TR41 in a resistor R41, in addition, having connected the opposite side edge section to the collector (that is, transmission line 4) of a transistor TR41 It is not necessary to necessarily connect with the transmission line 4, and since it is for impressing the constant voltage determined as the base of a transistor TR41 by diodes D41 and D42, as a dotted line shows to drawing, you may connect the end of this resistor R41 to other power supplies.
[0062] Next, the termination circuit 6 shown in drawing 5 (c) consists of junction type FETs 51 of an N channel by which the drain was connected to the transmission line 4, the source was grounded through the resistor R51, and the gate was grounded again. Thus, in the constituted termination circuit 6, a junction type FET 51 controls the bias voltage of the gate by the source current which it begins to pass itself, and the resistance of a resistor R51, and it operates with them so that fixed current may be absorbed from the transmission line 4. And according to this circuit, a termination circuit 6 can be constituted most easily.

[0063] Next, it hits and the practical communication device also in consideration of protection of the circuit for which the communication device in ECU2 is constituted is explained. Drawing 6 expresses an example of the communication device in ECU2 in the data communication unit using the current regulator circuit shown in the termination circuit 6 at drawing 5 (b).
[0064] As shown in drawing 6 , although the receiving circuit 20 is equipped with the resistors 20b and 20c for a judgment voltage Vs setup, and comparator 20a like the receiving circuit 20 shown in drawing 1 , in this communication device, 20d of resistors for the input protections of comparator 20a is further prepared on the signal line which connects comparator 20a and the transmission line 4.
[0065] Moreover, fundamentally, although the circuit shown in drawing 4 (a) is used, a driver circuit 10 In order to protect the transistor TR12 for the grand short shell current outputs of the transmission line 4 The resistor R15 prepared between the emitter of a transistor TR12, and the inductor L11, The PNP type transistor TR13 and ** by which the collector was connected to the base of a transistor TR12, the base was connected to the node of an inductor L11 and a resistor R15, and the emitter was connected to the power supply line are added. Consequently, when excessive current is likely to flow out of a driver circuit 10 by grand short-circuit of the transmission line 4, a voltage drop can occur in a resistor R15, a transistor TR13 can be in ON state, the base current of a transistor TR12 can be reduced, and it can prevent that an overcurrent flows from a transistor TR12 to the transmission line 4. That is, the overcurrent-protection circuit is formed with the resistor R15 and the transistor TR13.
[0066] Moreover, diodes D11 and D12 are formed so that an overvoltage may not be impressed to a driver circuit 10 from a transmission-line 4 side, and zener diode ZD11 is formed, and the signal on the transmission line 4 may not be affected, even if the current supply to ECU2 concerned stops further. That is, between the collector of the transistor TR12 for current outputs, and the transmission line, a cathode is made into a transmission-line 4 side, and diode D11 is formed, and the anode of diode D12 is connected to the transmission line 4, and the cathode of diode D12 is grounded through zener diode ZD11. Consequently, even if the overvoltage occurred in the transmission line 4, when the voltage can be held down to below the predetermined voltage determined by part for the breakdown voltage of zener diode ZD11, and the forward voltage drop of diode D12 and the current supply to ECU2 is intercepted by diodes D11 and D12, it can prevent that current flows in into ECU2 from a transmission-line 4 side.
[0067] As mentioned above, two or more ECU 2a-2n is connected through the one transmission line 4 as one example of this invention. By flowing current into the transmission line 4 out of the driver circuit 10 prepared in each ECU2, and absorbing the current which flows to the transmission line 4 by the termination circuit 6 side linked to the transmission line 4 The potential of the transmission line 4 is responded to a sending signal Tx, changing the current which flows to the transmission line 4 to ****, and suppressing a radiated noise, and it is High/Low. Although the data communication unit which one of binary level is made to change suddenly, and enabled it to realize exact data communication was explained For example, even if it constitutes a driver circuit 10 so that current may be absorbed from the transmission line 4, and it constitutes a termination circuit 6 so that fixed current may be flowed into the transmission line 4, the same effect as the above-mentioned example can be acquired.
[0068] Moreover, as shown, for example in drawing 7 , the transmission line 4 may be constituted from a twisted pair wire which consists of signal lines 4a and 4b of a couple, a driver circuit 10 may be constituted from a current source of the couple which performs an outflow and inflow of current to each signal lines 4a and 4b of the transmission line 4, respectively, and a termination circuit 6 may consist of constant current sources of the couple which performs an inflow and outflow of current to each signal lines 4a and 4b of the transmission line 4, respectively.
[0069] That is, the termination circuit 6 is equipped with three NPN type transistors TR71, TR72, and TR73 which an emitter is grounded and constitute current Miller circuit while the base of each other is connected, and two PNP type transistors TR74 and TR75 which an emitter is connected to a power supply line and constitute current Miller circuit while the base of each other is connected in the data communication unit shown in drawing 7 .
[0070] And like the transistor TR31 shown in drawing 5 (a), between the collector bases is

connected, while constitutes the transmission line 4 like the transistor TR32 shown in the collector of a transistor TR73 at drawing 5 (a), and the transistor TR71 is connected to signal-line 4a while a collector is connected to a power supply line through a resistor R71. Consequently, to a transistor TR71, the fixed current determined with supply voltage Vc and the resistance of a resistor R71 flows, and a transistor TR73 comes to absorb the same fixed current as this from signal-line 4a to it.
[0071] Moreover, the collector of a transistor TR72 is connected to the collector of a transistor TR74, it connects mutually between the collector bases of a transistor TR74, and the collector of the transistor TR75 which constitutes current Miller circuit with a transistor TR74 further is connected to another [which constitutes the transmission line 4] signal-line 4b. Since the transistor TR72 constitutes current Miller circuit with transistors TR71 and TR73, to a transistor TR72, the same fixed current as the suction current from signal-line 4a which flows to transistors TR71 and TR73 flows through a transistor TR74. Consequently, the same fixed current as this suction current will flow also to a transistor TR74, as a result a transistor TR75, and this fixed current will flow into them out of the collector of a transistor TR75 at signal-line 4b.
[0072] That is, in the termination circuit 6 shown in drawing 7 , transistors TR73 and TR75 function as a current source which passes fixed current, respectively, and fixed current is absorbed from one signal-line 4a of the transmission line 4, and it operates so that fixed current may be supplied to signal-line 4b of another side. On the other hand in the communication device in ECU2, the receiving circuit 20 is constituted by the comparator CP which compares the potential of each signal lines 4a and 4b. To High level, it compares, when the potential of signal-line 4a is high compared with the potential of signal-line 4b, it compares with reverse at the potential of signal-line 4b, and the potential of signal-line 4a is Low at the time of a low. The input signal Rx used as level is generated, and it is made to be inputted into communication IC 8.

[0073] Moreover, in the communication device in ECU2, the driver circuit 10 consists of a driver circuit for an outflow which flows current into one signal-line 4a of the transmission line 4, and a driver circuit for an inflow which absorbs current from another signal-line 4b of the transmission line 4. The driver circuit for an outflow like the driver circuit 10 shown in drawing 4 (a), and abbreviation And the NPN type transistor TR61, The sending signal Tx outputted from communication IC 8 is inputted into the base of a transistor TR61 as the PNP type transistor TR62. The resistor R62 for changing a transistor TR61 into ON state, when a sending signal Tx is High level, In order to restrict the current which flows at the time of ON of a transistor TR61, while being prepared in series between the collector of a transistor TR61, and a power supply line The resistors R64 and R65 of a couple by which the node was connected to the base of a transistor TR62 in order to make base voltage of a transistor TR62 lower than supply voltage at the time of ON of a transistor TR61, By consisting of inductors L61 prepared between the emitter of a transistor TR62, and the power supply line, and connecting the collector of a transistor TR62 to one signal-line 4a of the transmission line 4 Gradual increase and the current iLa to dwindle are made to flow into signal-line 4a according to a sending signal Tx.
[0074] On the other hand, the driver circuit for an inflow reverses the driver circuit for an outflow. The NPN type transistor TR63, The sending signal Tx outputted from communication IC 8 is inputted into the base of a transistor TR63. The resistor R63 for changing a transistor TR63 into ON state, when a sending signal Tx is High level, It consists of a grounding resistor R61 formed in the communication IC 8 side of a resistor R63, and an inductor L62 prepared between the emitter of a transistor TR63, and the ground line. By connecting the collector of a transistor TR63 to one signal-line 4b of the transmission line 4, gradual increase and the current iLb to dwindle are absorbed according to a sending signal Tx from signal-line 4b.
[0075] In addition, for a grounding resistor R61, a sending signal Tx is High level to Low. It is for decreasing to **** the current which is process in which a transistor TR63 shifts to an OFF state, it is reversed on level, passes current to the base side of a transistor TR63 when the emitter voltage of a transistor TR63 falls further rather than the potential of a ground line by the energy accumulated at the inductor L62, and flows to a transistor TR63.

[0076] And since the noise generated in the signal lines 4a and 4b of the couple which constitutes the transmission line 4 can be made to offset mutually according to the data communication unit shown in drawing 7 constituted in this way, generating of a radiated noise can be suppressed more certainly and the precision of data communication can also improve.

[Translation done.]